GARY R. HERBERT
Governor
GREG BELL
Lieutenant Governor

State of Utah
DEPARTMENT OF NATURAL RESOURCES
MICHAEL R. STYLER
Executive Director
Division of Water Rights
KENT L. JONES
State Engineer/Division Director

February 19, 2013

RE: Stream Channel Alteration No. 13-57-07SA
Red Butte Creek
Chevron Pipe Line Company

Attached is a copy of an application to alter a natural stream, which has been submitted to the Division of Water Rights (Division) for processing.

In processing this application, the Division will work to determine if the project will:

- Unreasonably or unnecessarily affect any recreational use or the natural stream environment;
- Unreasonably or unnecessarily endanger aquatic wildlife;
- Unreasonably or unnecessarily diminish the natural channel's ability to convey high flows; or
- Impair vested water rights.

Any decision made regarding this application will be based exclusively on these four criteria. If you have information regarding these four criteria that will aid the Division in making a determination and subsequent decision, please submit this information, in writing, to this office prior to **March 11, 2013**. For questions or comments pertaining to all other aspects of the project, please contact the applicant listed on the front page of the application directly.

Sincerely,

Tiffany Gonzales
for Chuck Williamson, P.G.
Stream Alteration Specialist

Pc: Richard Clark - EPA
Corps of Engineers
Supervisor - U. S. Fish & Wildlife
Teresa Wilhelmsen - Regional Engineer
Mark Farmer - Regional Wildlife Habitat Manager
Carmen Bailey - Aquatic Habitat Coordinator
Bill Damery - DEQ, Water Quality Division
Laura Ault - Forestry Fire & State Lands
Kelly Beck - RDCC Coordinator
State Parks & Recreation
Lori Hunsaker - State History
W. D. Robinson - Department of Agriculture
Judy Watanabe - CEM
Chris Springer - Salt Lake County

1594 West North Temple, Suite 220, PO Box 146300, Salt Lake City, UT 84114-6300
telephone (801) 538-7240 • facsimile (801) 538-7467 • TTY (801) 538-7458 • *www.waterrights.utah.gov*

UTAH DNR WATER RIGHTS

Rec. by CAWC
Fee Rec. $2,000
Receipt 13-00619
CHK No. 25633

JOINT PERMIT APPLICATION FORM

U.S ARMY CORPS OF ENGINEERS – FOR SECTIONS 404 AND 10
UTAH STATE ENGINEER'S OFFICE – FOR NATURAL STREAM CHANNELS

Application Number (assigned by): _____ / 13-57-07SA
Corps / State Engineer

Applicant's Name (Last, First M.I. or entity if not an individual)	Authorized Applicant Representative (if any)	Applicant's Telephone Number and Area Code Representative's Telephone Number and Area Code
Chevron Pipe Line Company	EarthFax Engineering, Inc.	801-975-2353 801-561-1555

Applicant's Address (Street, RFD, Box, Number, City, State, Zip)

2875 S Decker Lake Drive, Suite 150
Salt Lake City, Utah 84119

X: 429479.87 **PROJECT LOCATION** Y: 4511703.93

Quarter Section(s)	Section	Township	Range	Base & Meridian
SE SE	4	1 So.	1 E.	SLB&M

County	Associated Watercourse or Watercourse to be Altered	Check one: ☒ Within City Limits ☐ Outside City Limits List town or nearest town:
Salt Lake	Red Butte Creek	Salt Lake City

Project location or address:

Red Butte Creek at Hall Street
N 40.755010° W 111.836150

Brief description of project including methods and equipment to be employed to complete the work:

Site located at the crossing of Red Butte Creek and Hall St. at the VA Hospigal N 40.755010° W 111.836150 in Salt Lake City, Utah. Work will include the placing of approximately 1cy of riprap to repair a portion of bank and existing storm drain outfall. Work will be performed using hand tools and manual labor. Access will be by foot from Hall St. as coordinated with the VA. Design sketches and calculations are attached.

Purpose (justification) of project:

Repair of existing storm drain outfall to prevent further erosion and undermining of the structure.

Is this a single and complete project or is part of a larger project, continuing project, or other related activities? If so, please describe the larger project or other related activities.

Single repair project

If project included the discharge of dredged or fill material into a watercourse or wetland:

Cubic yards of material: approximately 1 cy

Acreage or square footage of waters of the United States affected by the project: 24 sf

Source and type of fill material: class III and IV riprap from local source

Length of stream that will be impacted below ordinary high water elevation: approximately 10 ft

RECEIVED
FEB 07 2013
WATER RIGHTS
SALT LAKE

Alternatives (other ways to accomplish project purpose):

The existing outfall system included riprap. The proposed repairs are a replace in kind. No other mitigation systems were evaluated.

Describe any proposed mitigation to offset impacts to the stream channel.

Work will occur during low streamflow conditions. Approximately one cubic yard of clean, angular graded riprap will be placed at the base of the existing concrete outfall pad to protect it from scour. The rock will be placed such that it does not protrude into the channel or alter the downstream flowline or hydraulics of Red Butte Creek.

Cultural resource impacts:

Are you aware of any cultural resources or any historic properties that will be impacted by the proposed project? ☐ Yes ☒ No
If Yes, please explain:

Has a cultural resource survey been conducted on the property where the proposed project is to occur? ☐ Yes ☐ No X
If Yes, please briefly explain the survey results:

List other authorizations required by Federal, state, or local governments (i.e.: National Flood Insurance Program), and the status of those authorizations.

A flood control permit has been requested from Salt Lake County Flood Control along with a riparian corridor permit from Salt Lake City Public Utilities. These permit requests are currently under review.

Estimated starting date of project:	Estimated completion date:
February 2013	July 2013

Please complete the following checklist

Failure to indicate that all pertinent information has been submitted will result in your application being returned.

- ☒ Appropriate application processing fee payment (see fee schedule below).
- ☒ A clear site location map with enough detail to easily find the site, a recent aerial/satellite image of the site, and a USGS topography map (7.5 minute quadrangle map is recommended).
- ☒ Plan view and cross-sectional drawings showing all work requiring a permit, including fills, structures, borrow sites, staging areas and storage areas. The drawings must clearly demarcate the ordinary high water mark of the waters of the U.S. to be impacted. Professional drawings are not required; however, drawings must be scaled or indicate dimensions of the work to be completed.
- ☒ A restoration plan for any areas temporarily disturbed during work, including re-contouring, revegetation with appropriate native plants and maintenance and monitoring to ensure success for the restored area.
- ☒ Ground photographs taken from various locations of the proposed disturbance area.
- ☒ Please check the box if the proposed project involves bank stabilization or protection. If so, please complete the following:
  - ☒ A narrative demonstrating the proposed activity incorporates the least damaging bank protection methods. These methods include, but are not limited to, the use of bioengineering, biotechnical design, root wads, large woody debris, native plantings, and beach nourishment in certain circumstances. If rock must be used due to site erosion conditions, explain how the bank stabilization structure incorporates elements beneficial to aquatic organisms.

- ☒ A description of current and expected post-activity sediment movement and deposition patterns in and near the activity area.
- ☒ A description of current and expected post-activity habitat conditions, including the presence of fish, wildlife and plant species in the activity area.
- ☒ An assessment of the likely impact the work would have on upstream, downstream and cross-stream properties (at a minimum the area assessed should extend from the nearest upstream bend to the nearest downstream bend of the watercourse). Specifically, discuss how the project will impact the following:
  - Will the activity accelerate deposition or erosion?
  - Will impacts to sensitive species or habitats result from a change in suspended sediment load or turbidity?
  - Will the activity affect the diversity of the channel by eliminating in-stream habitat, meanders, or gravel bars?
  - Will the activity result in a shift in the main flow patterns?
- ☒ A planting plan which involves the use of native riparian plants, unless the applicant demonstrates it is not appropriate or not practicable.

Application is hereby made for a permit or permits to authorize the activities described herein. I certify that I am familiar with the information contained in the application, and that to the best of my knowledge and belief, such information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed activities or am acting as the duly authorized agent of the applicant which is a **(check one of the following) commercial ☐, non-commercial ☐, or governmental ☐ entity.**

Signature of Applicant Lloyd Watkins Date: Feb 7th, 2013

Lloyd Watkins, SERIP Advisor

I hereby certify that EarthFax Engineering, Inc. is acting as my agent on this project.

Agent's address and telephone number: 7324 S Union Park Avenue, Suite 100, Midvale, Utah 84047

801-561-1555

Filing Instructions

Application supplements should be submitted on paper no larger than 11 x 17 inches or alternatively as PDF format electronic files. If more than one watercourse is to be altered as a result of the project, a separate application must be submitted for each watercourse. Application fees must be received by the Division of Water Rights at the time of application submission and must be either hand delivered or submitted through standard mail.

Application Processing Fees

Application fees are based on the type of entity applying for the proposed stream alteration project.

Commercial Entities:	$2000.00	per application processed.
Non-Commercial Entities:	$100.00	per application processed.
*Governmental Entities:	$500.00	per application processed.

Repairs to Red Butte Creek
VA Hospital Storm Drain Outfall
Design Summary Report

Chevron Pipe Line Company
Salt Lake City, Utah

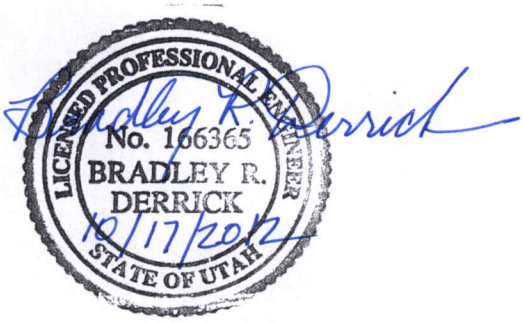
September 2012

EarthFax Engineering, Inc.
Engineers / Scientists
7324 South Union Park Avenue, Suite 100
Midvale, Utah 84047
USA
801-561-1555
www.earthfax.com

Repairs to Red Butte Creek
VA Hospital Storm Drain Outfall
Design Summary Report

Chevron Pipe Line Company
Salt Lake City, Utah

September 2012



EarthFax EarthFax Engineering, Inc.

Engineers / Scientists
www.earthfax.com

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

REPAIRS TO RED BUTTE CREEK - VA HOSPITAL STORM DRAIN OUTFALL REPAIR DESIGN REPORT

CHAPTER 1
INTRODUCTION

The cleanup and recovery operations along Red Butte Creek following a June 2010 crude oil release have been determined to have damaged a section of stream bank at a storm drain outlet at the Veterans Administration Hospital (VA) in Salt Lake City, Utah. The damage was further exacerbated during the high flow runoff volumes from winter snow melt during the spring of 2011. To preclude future erosion of the storm drain outfall and creek bank at this location, Chevron Pipe Line (CPL) has agreed to work with the VA, Salt Lake County (County), and Salt Lake City (City) to rebuild and stabilize the outfall channel and creek bank at this storm drain location.

The location of the storm drain outfall, marked as "VA of 1," is shown in the aerial photograph as Site #29 on page 1 of 2 in Attachment A. Photographs of the outfall headwall taken by Bio-West as Part of their Red Butte Creek Post-Oil Release Stream Channel, Physical Habitat, and Riparian Vegetation Evaluation Final Report are shown on page 2 of 2 in Attachment A.

This document was prepared by EarthFax Engineering, Inc. (EarthFax) in conjunction with Bio-West, Inc. (Bio-West) to summarize the methods and calculations used to design the storm drain channel and creek bank repairs for permitting of the proposed repair work at the site.

CHAPTER 2
DESIGN APPROACH

2.1 EXISTING CONDITIONS

Runoff enters the main channel of Red Butte Creek from a storm drain outfall (VA of 1) from the north bank just west of the large culvert crossing under Hall Street on the VA Hospital property in Salt Lake City, Utah. The main creek channel in this area consists generally of near vertical soil and rock banks approximately two feet in height and then variable slopes of 2:1 or 3:1 (see page 1 of 2 in Attachment B). The upper banks on both sides of the channel, north and south, typically consists soil and vegetative cover. The bottom of the channel is lined with cobble of varying size intermixed with broken sections of waste concrete. The storm drain outfall has been scoured clean of riprap and the main channel bank has been undercut into the outfall by up to three feet, leaving the bottom of the channel and north bank exposed to further erosion.

Red Butte Creek is approximately 8.4 feet wide across the bottom of the channel and 10.4 feet across at the top of the vertical banks. The average slope of the main channel is 0.031 feet per foot (ft/ft) with a maximum local slope of 0.042 ft/ft as measured in the Bio-West Study (page 1 of 6 in Attachment C). The outfall (headwall) structure has a splash pad that is 1.5 feet wide by 2 feet deep with a slope of approximately 1.5H:1V (see page 2 of 2 in Attachment B).

While there does not appear to be much difference in the photographs showing the rock at the outfall, it appears that cleaning activities damaged vegetation and shifted rocks that previously stabilized the bank at the inlet to the channel which allowed the heavy spring runoff of 2011 to cause additional movement of these rocks and erosion of the bank to extend towards the structure and widen at the bank.

2.2 HYDROLOGIC METHODS AND CALCULATIONS

2.2.1 Storm Drain Flow and Velocity

The maximum water velocity and flow from the storm drain outlet were modeled using FlowMaster Version 6.0. This model evaluates conditions based on the solution of Manning's one-dimensional energy equation (Eq. 2-1):

$$v = \frac{1.49}{n} R^{2/3} S^{1/2}$$

where v = average velocity of flow at a given cross section (ft/s)
R = hydraulic radius of the cross section (ft)
S = slope of the pipe (ft/ft)
n = Manning's roughness coefficient

The solution of this equation requires data concerning the pipe slope, pipe cross section, and roughness coefficient for the pipe. The pipe type and diameter are based on site observations and measurements (See page 2 in Attachment B). Slope of the drain was assumed to be at a minimum for self-cleansing velocity and topographic data from existing mapping of the site. Based on a review of site conditions and typical values for vitrified clay pipe, the following values were used for the storm drain:

Pipe Diameter (Inches): 15
Pipe Depth (R): 1.25 (Pipe flowing full)
Pipe Slope (S): 0.015
Pipe Type (n): 0.013

Therefore, the peak flows anticipated from the storm drain outfall is approximately 8 cubic feet per second (cfs), see pages 4 and 5 of 6 in Attachment C. However, the existing configuration of the outfall structure this peak flow will cause the stormwater to free fall when exiting the pipe. Therefore, the required diameter of the rock in the splash pad/channel is calculated using the equation describing the instantaneous velocity of an object in freefall:

$$V = (2gd)^{1/2}$$

Were V is the velocity (ft/s), g is the acceleration due to gravity (32.2 ft/s^2), and d is the vertical distance (ft). With the free fall from the drain pipe to the top of the new riprap at 16-inches, the maximum velocity felt by the rock is 9.3 ft/s. With some water covering the splash pad, up to 9-inches during design storm events, the velocity against the riprap will be slightly less, thus providing some additional factor of safety for this design.

2.2.2 Main Channel Flow and Velocity

A hydrological analysis for Red Butte Creek was performed by EarthFax to establish a maximum design flow for channel repairs at Red Butte Gardens Arboretum, 1365 East Harvard Avenue, and 1109 East Harvard Avenue. This same design flow and recurrence interval will be used for design for channel repairs at the VA. The required supporting information and calculations to support the design storm is contained the EarthFax report, "Proposed Channel Improvements to Red Butte Creek at 1365 East Harvard Avenue" and is summarized below.

Salt Lake County maintains a stream gauging station on Red Butte Creek at 1600 East. Although streamflow data have been collected from this location since 1984, annual peak flow data have been retained by the County only since 2007. Since this is an insufficient time upon which to base long-term projections, peak flows at the subject property were determined using the regional regression equations of Kenney et al. (2008). For the area of Red Butte Creek

(Geohydrologic Region 2 of Kenney et al. [2008]), the regression equations predict peak flow based on the drainage area and the mean annual precipitation in the contributing watershed.

The drainage area above the subject site was determined to be 11.54 mi^2 based on USGS topographic maps and a review of stormwater conveyance structures in the area. The mean annual precipitation in the watershed was determined to be 29.1 inches based on data downloaded from the Parameter-elevation Regressions on Independent Slopes Model (PRISM) web site (http://prism.oregonstate.edu/products). Based on these values, the peak flows contained in Table 1 were calculated for the subject site.

It is recognized that the regression equations of Kenney et al. (2008) were developed for natural, unregulated streams and do not strictly apply to Red Butte Creek (with a reservoir and urban land use upstream from the subject property). Although actual peak flows may be higher than predicted by these equations due to the presence of urban conditions, actual peak flows are probably much lower than predicted due to the presence of the upstream reservoir. For the sake of this analysis, it was conservatively assumed that these two factors cancel each other out. Therefore, the peak flows presented in Table 1 have been compiled for design purposes. The flow of 169 cfs (with a recurrence interval of 100 years) was used for this design.

The depth of water and velocity of flow in the main channel were modeled using FlowMaster Version 6.0 for the design flow of 169 cfs. Using Manning's equation (Eq. 2-1) above where:

v = average velocity of flow at a given cross section (ft/s)
R = hydraulic radius of the cross section (ft)
S = slope of the water surface (ft/ft)
n = Manning's roughness coefficient

The solution of this equation requires data concerning the channel cross section as well as an estimate of the roughness coefficient. Existing main channel cross sections were prepared based on site measurements (see pages 1 of 2 of Attachment B) and topographic data gathered by Bio-West during their Study (see page 1 of 6 in Attachment C) for Reach LRB 5B. Based on a review these site conditions and typical values provided by Haan et al. (1994), a Manning's roughness coefficient (n) was selected for a channel bottom of cobble.

In addition to the channel characteristics as noted and the maximum anticipated flow from the 24-hour 100-year recurrence interval, the main channel will see a maximum velocity of 9.6ft/s, slightly less at the banks (see pages 2 and 3 of 6 in Attachment C).

CHAPTER 3
PROPOSED CHANNEL REPAIRS

3.1 CONSTRUCTION PLAN

A plan view of the main channel with cross sections 10 feet above and below the outfall, along with details of the outfall and proposed channel repairs, are provided in Attachment B. The site is located on a steep, forested bank with limited access. Therefore, all work will be accomplished using hand tools and manual labor. The proposed repair consists of the addition of approximately 1 to 2 cubic yards of riprap protection to enlarge the outfall splash pad and re-establish a portion of the north-channel bank. The proposed repairs will consist of the following:

- Key-in and rebuild the north main channel bank with appropriately sized hand placed riprap at the storm drain outfall.
- Enlarge the splash pad area of the outfall with appropriately sized riprap to be held in place by the new channel bank riprap
- Rebuild the bottom and sides of the outfall channel with riprap to provide an erosion-stable base.

Calculations for the main channel presented in Section 2 indicate that the banks, both upstream and downstream from the outfall are capable of containing the peak flow of 169 cfs. However, the north bank at the outfall needs to be rebuilt to avoid undermining of the outfall structure. The peak velocity in the channel of 9.6 feet per second (ft/s) requires a minimum riprap size of 11-inch (D_{50}) or equivalent County Gradation Class III for rock at on a slope of 1.5H:1V, (see page 6 of 6 in Attachment C). Further, following direction from the County, the next larger gradation class (Class IV, D_{50} = 15-inch) will be used for the bank repair. See Salt Lake County Supplemental Specification to APWA Standard Specification 31 37 00 – Riprap or Rock Lining contained in Attachment D. The largest fraction of this rock (20-inch to 25-inch) will be keyed (excavated) into the channel bottom at least half of its diameter without protruding into the main channel or alter the downstream flow-line or hydraulics of the Creek.

Calculations for the free fall from the drain pipe to a splash pad/channel presented in Section 2 indicate the maximum velocity felt by the rock is 9.3 ft/s. This peak velocity requires a minimum riprap size of 7-inch (D_{50}) or equivalent County Gradation Class II for rock at 12H:1V or channel bottom, (see page 6 of 6 in Attachment C). Further, following direction from the County, the next larger gradation class (Class III, D_{50} = 12-inch) will be used for the Splash pad. See Salt Lake County Supplemental Specification to APWA Standard Specification 31 37 00 – Riprap or Rock Lining contained in Attachment D. This rock will be keyed (excavated) into the channel bottom at least half of its diameter and placed two feet deep behind the new Creek bank riprap.

CHAPTER 4
REFERENCES

Bio-West, Inc., February 2012. Red Butte Creek Post-Oil Release Stream Channel, Physical Habitat, and Riparian Vegetation Evaluation. Final Report. Logan, Utah.

Bio-West, Inc. 2010. Salt Lake City Riparian Corridor Study: Final Red Butte Creek Management Plan. Project report submitted to Salt Lake City Department of Public Utilities. Logan, Utah.

Brown, S.A. and E.S. Clyde. 1989. Design of Riprap Revetment. Hydraulic Engineering Circular No. 11. U.S. Department of Transportation, Federal Highway Administration. McLean, Virginia.

EarthFax Engineering, Inc., April 2012. Proposed Channel Improvements to Red Butte Creek at 1365 East Harvard Avenue. Salt Lake City, Utah

Haan, C.T., B.J. Barfield, and J.C. Hayes. 1994. Design Hydrology and Sedimentology for Small Catchments. Academic Press. San Diego, California.

Kenney, T.A., C.D. Wilkowske, and S.J. Wright. 2008. Methods for Estimating Magnitude and Frequency of Peak Flows for Natural Streams in Utah. Scientific Investigations Report 2008-5158. U.S. Geological Survey. Salt Lake City, Utah.

TABLE 1

Estimated Peak Flows in Red Butte Creek
VA Hospital (Site #29)

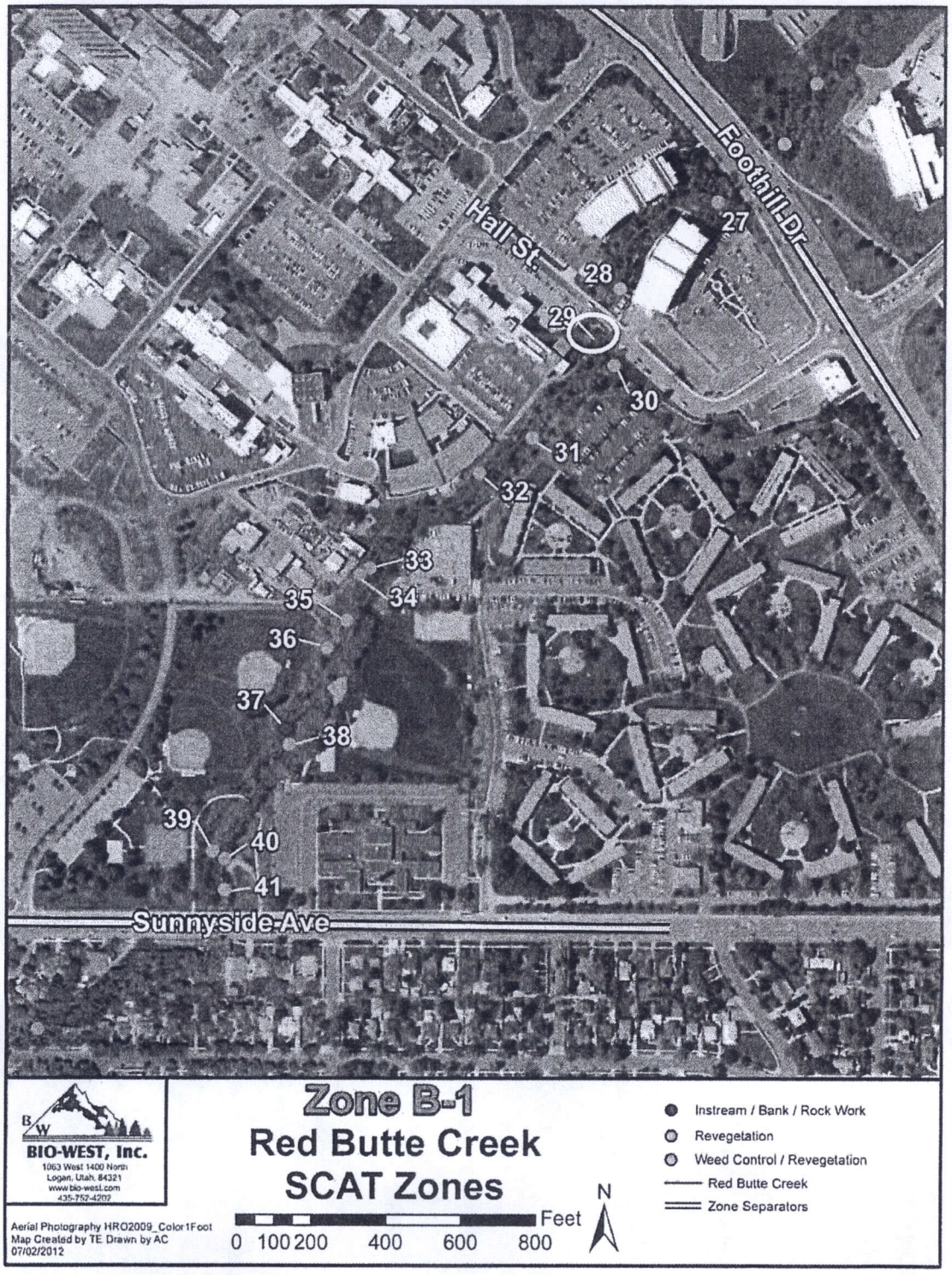
Return Period (yr)	Peak Flow (cfs)
2	33
5	69
10	76
25	110
50	138
100	169

ATTACHMENT A

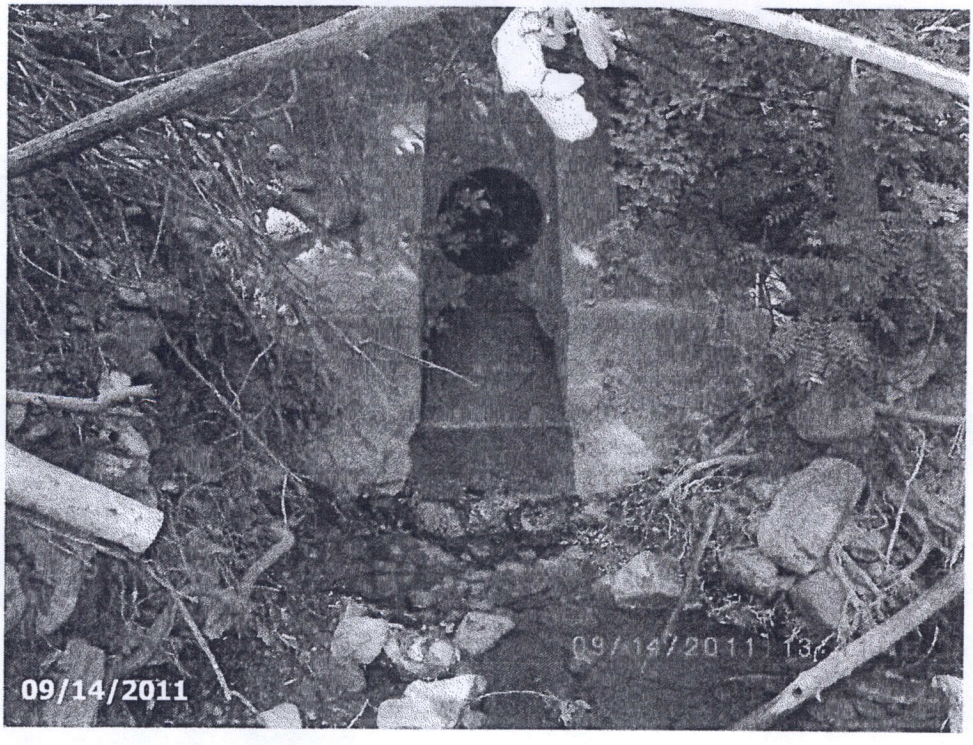
Photographs

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS

PROJECT RED BUTTE PAGE 1 OF 2
COMPUTED BRD DATE 09/26/2012
CHECKED _____ DATE _____



. Map showing approximate staging area for Recommendation Point #29 (white circle).



Photos of outfall at Recommendation Point #29 before and after spring 2011 high flows.

ATTACHMENT B

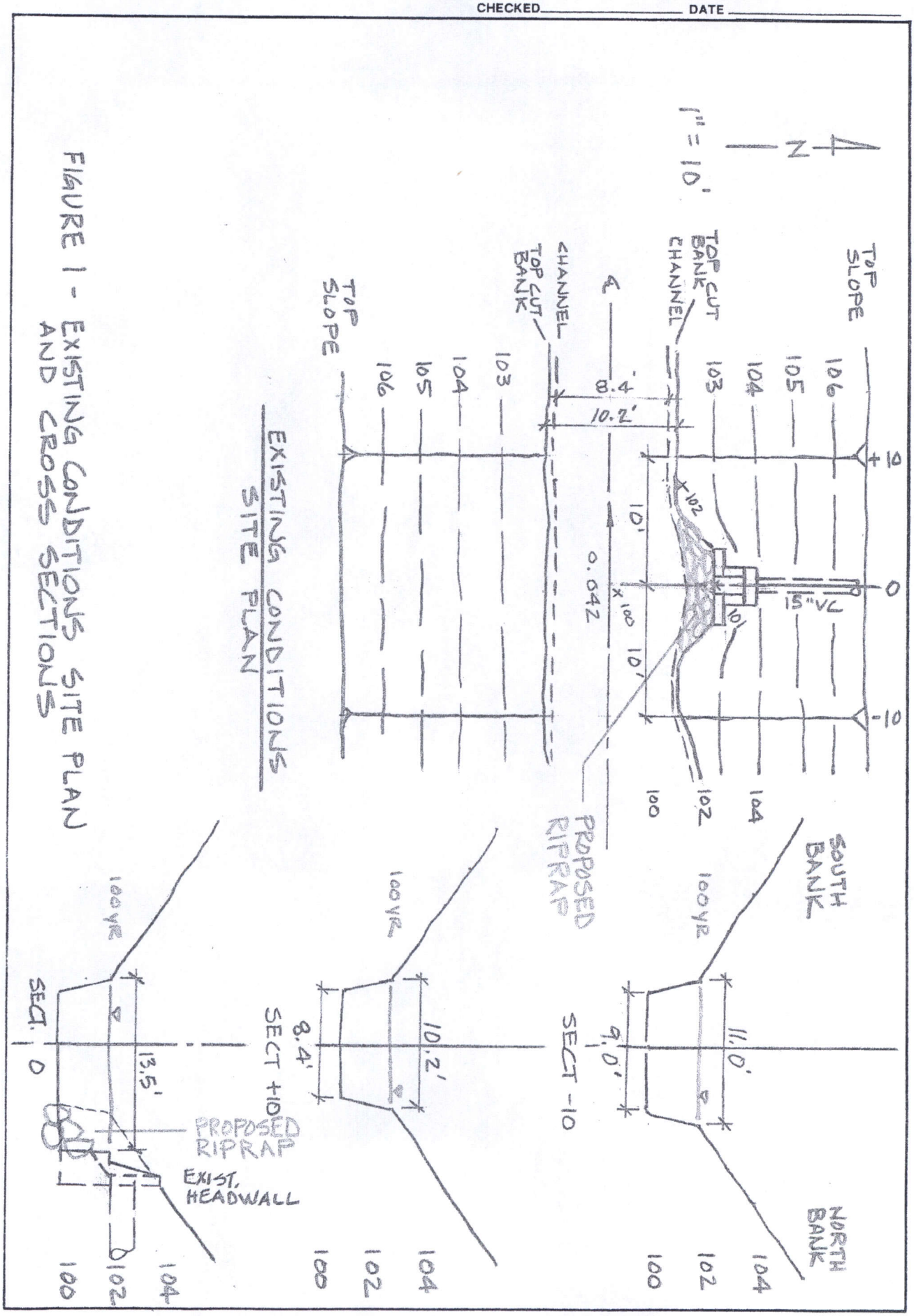
DRAWINGS

Existing Conditions Site Plan and Cross Sections, Sheet 1 of 2
Existing Headwall and Riprap Repairs, Sheet 2 of 2

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS

PROJECT RED BUTTE PAGE 1 OF 2
COMPUTED BRD DATE 09/25/2012
CHECKED DATE

FIGURE 1 - EXISTING CONDITIONS SITE PLAN AND CROSS SECTIONS



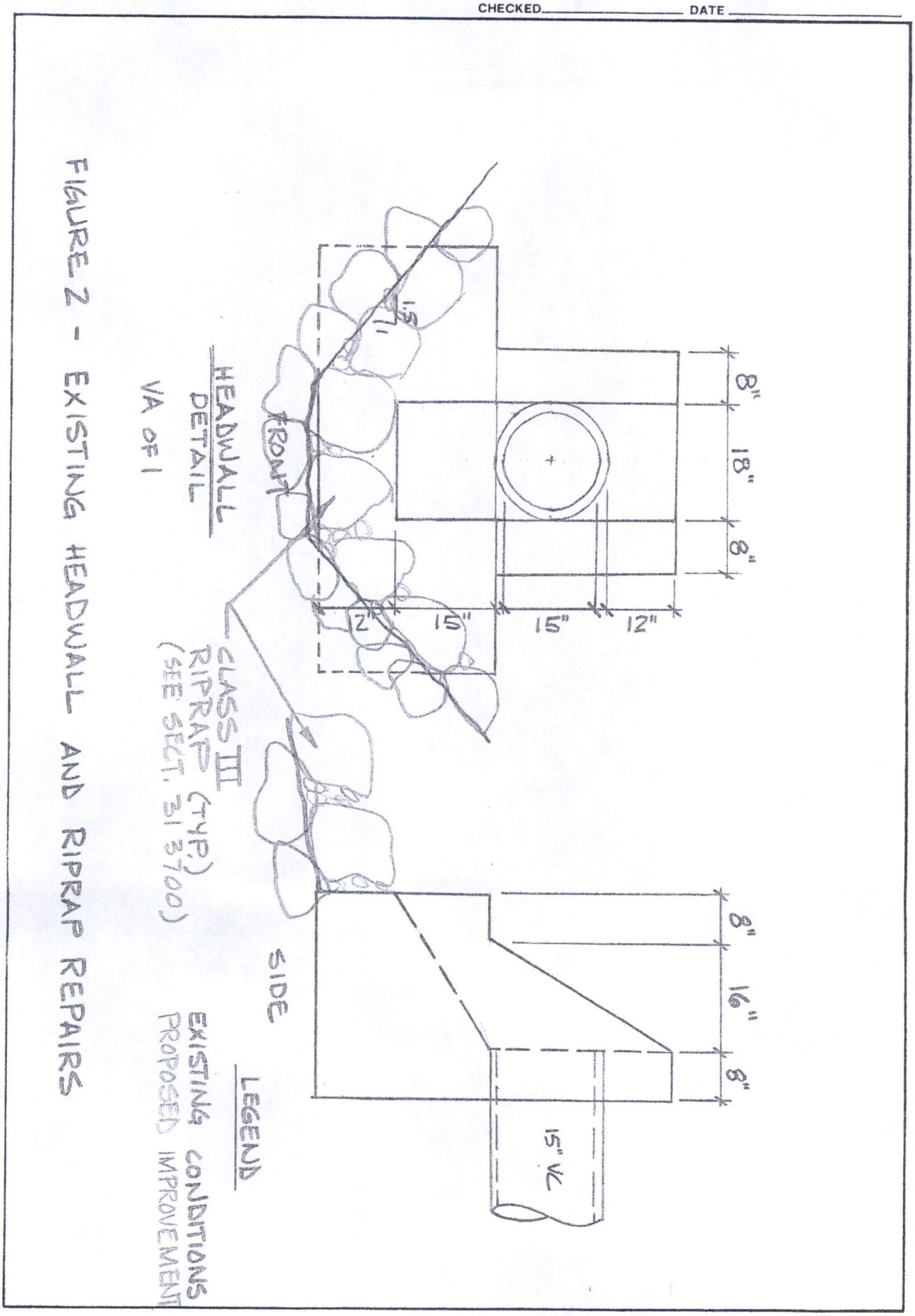


FIGURE 2 - EXISTING HEADWALL AND RIPRAP REPAIRS

ATTACHMENT C

Hydrologic and Hydraulic Calculations

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS

PROJECT RED BUTTE PAGE 1 OF 6
COMPUTED BRD DATE 09/26/2012
CHECKED DATE

Measured Values at Riffle Cross-Section								Reach Data	
	Streambed Material Size Data				Channel Geometry Data				
Reach Number	D16 (mm)	D50 (mm)	D84 (mm)	Percent Embedded	Low Flow Wetted Width (ft)	Wetted Width (ft) at 16 cfs	Local Slope (ft/ft)	Reach Slope (ft/ft)	Reach Length (ft)
URB 9	12	75	164	25	10.0	10.5	0.036	0.051	2297
URB 10	-	-	-	-	-	-	-	0.067	827
LRB 1	6	51	111	9	6.7	16.2	0.023	0.043	281
LRB 2	<2	12	27	5	7.0	11.3	0.009	0.053	451
LRB 3	5	30	181	32	10.8	11.1	0.094	0.062	1041
LRB 4A	<2	23	86	15	4.3	6.0	0.032	0.053	961
LRB 4B	9	45	95	11	6.3	8.9	0.018	0.040	595
LRB 4C	3	27	79	16	7.9	8.6	0.048	0.032	1294
LRB 5A	9	42	104	6	9.9	10.4	0.054	0.055	433
LRB 5B	12	41	104	4	8.4	10.2	0.042	0.031	1081
LRB 5C	9	42	134	16	5.8	7.6	0.028	0.037	887
LRB 6	-	-	-	-	-	-	-	0.046	492
LRB 7	12	37	111	10	9.4	10.0	0.021	0.036	2084
LRB 8	-	-	-	-	-	-	-	0.044	1059
LRB 9	-	-	-	-	-	-	-	0.053	633
LRB 10	10	32	77	3	5.8	7.4*	0.057	0.041	1449
LRB 11	-	-	-	-	-	-	-	0.043	301

** wetted width at 10.5 cfs*

EXISTING MAIN CHANNEL CONDITIONS

RBC Section at VA of 1 Inlet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	042000	ft/ft
Left Side Slope	4.00	V : H
Right Side Slope	4.00	V : H
Bottom Width	8.40	ft
Discharge	169.00	cfs

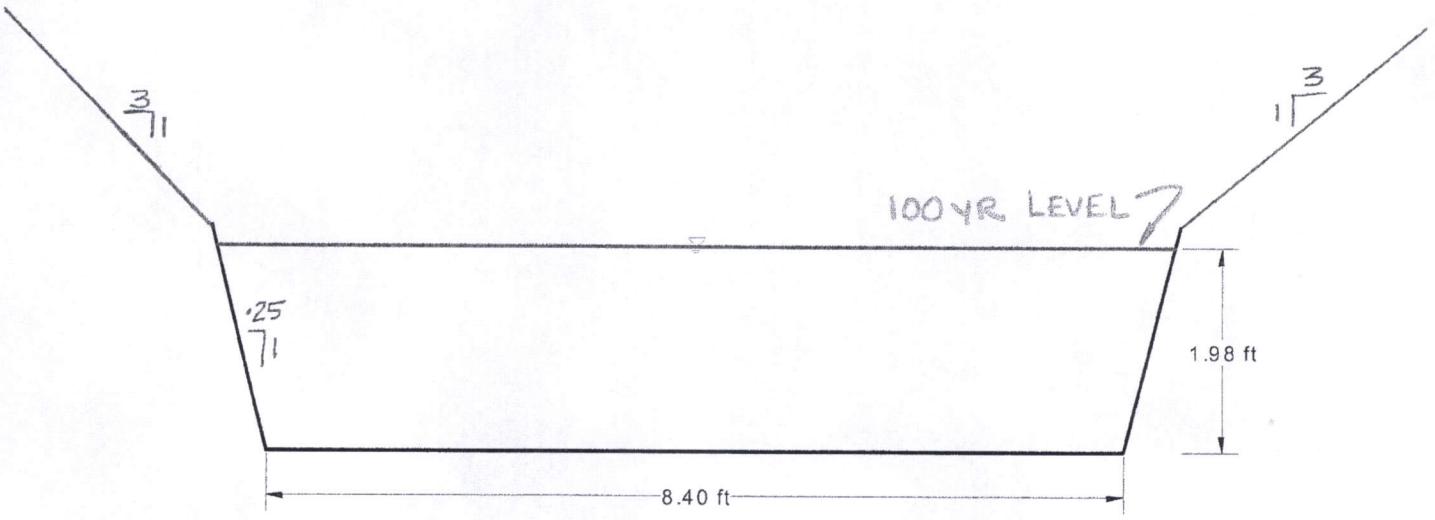
100 YR

Results		
Depth	1.98	ft
Flow Area	17.6	ft²
Wetted Perim	12.49	ft
Top Width	9.39	ft
Critical Depth	2.27	ft
Critical Slope	0.027598	ft/ft
Velocity	9.58	ft/s
Velocity Head	1.43	ft
Specific Energ	3.41	ft
Froude Numb	1.23	
Flow Type	Supercritical	

Cross Section
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channe
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coeffic	0.040	
Slope	042000	ft/ft
Depth	1.98	ft
Left Side Slope	4.00	V : H
Right Side Slope	4.00	V : H
Bottom Width	8.40	ft
Discharge	169.00	cfs



RED BUTTE CREEK
MAIN CHANNEL
SECTION

VA of 1 Outlet
Worksheet for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Discharge

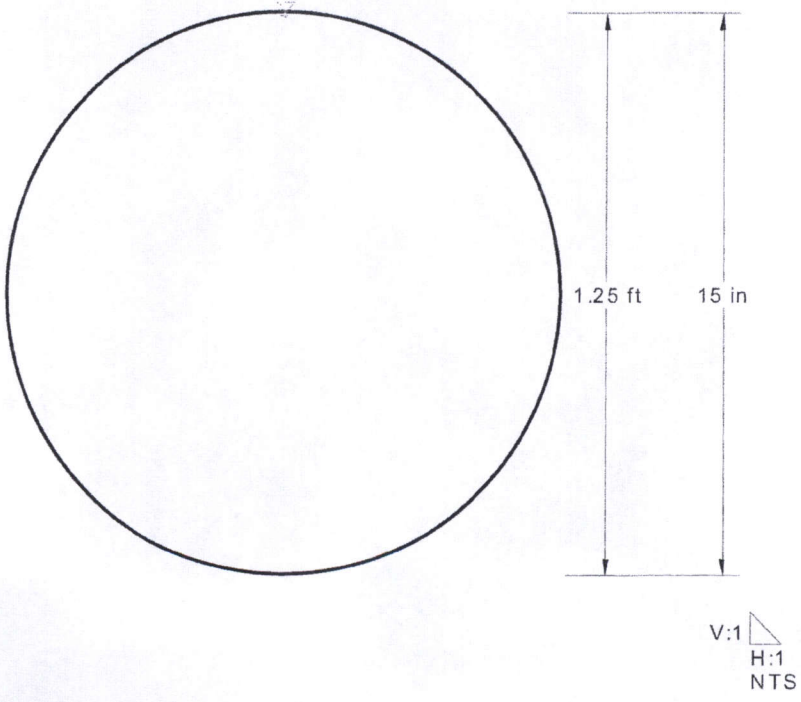
Input Data		
Mannings Coeffic	0.013	
Slope	015000	ft/ft
Depth	1.25	ft
Diameter	15	in

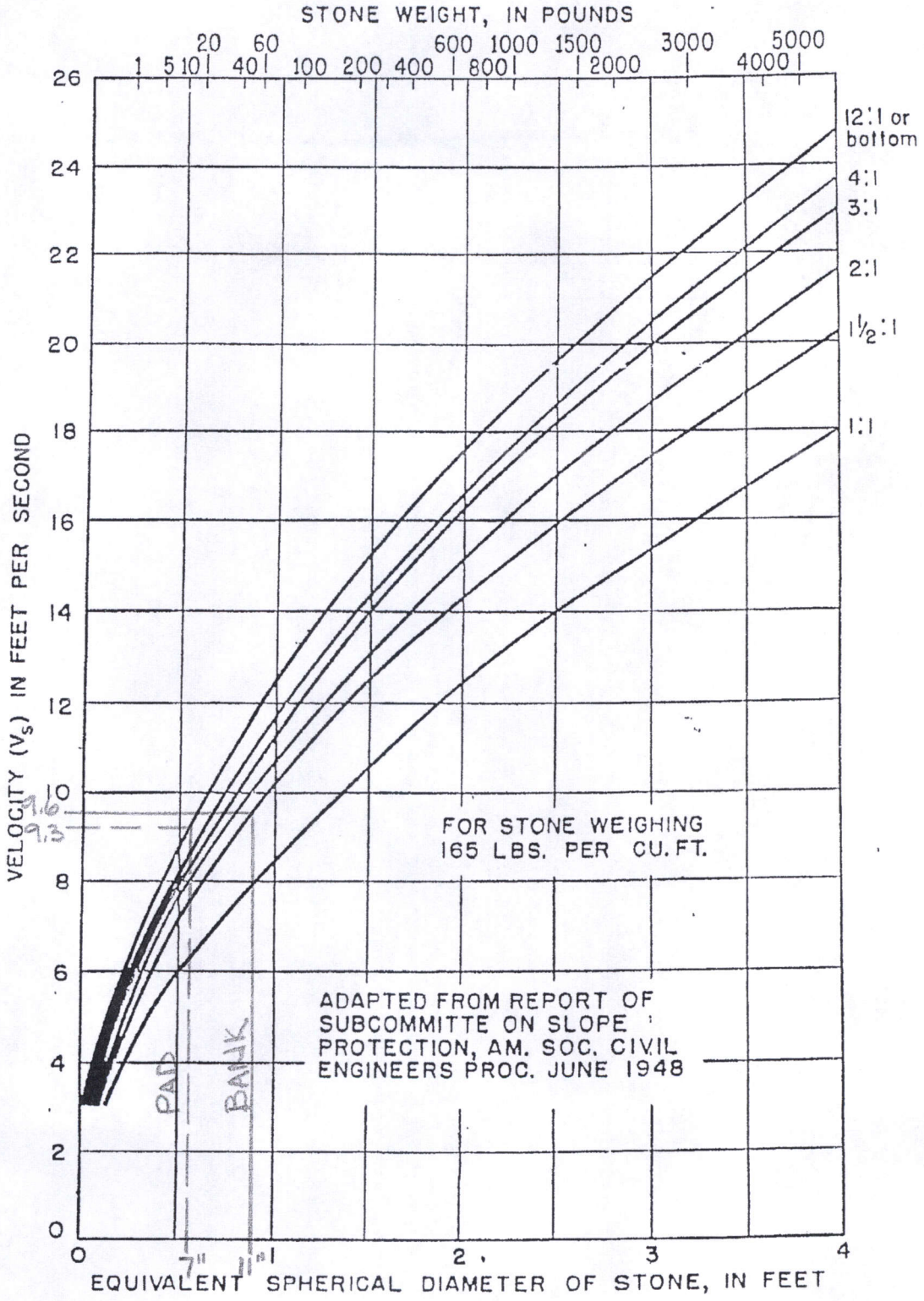
Results		
Discharge	7.91	cfs
Flow Area	1.2	ft²
Wetted Perime	3.93	ft
Top Width	3.33e-8	ft
Critical Depth	1.11	ft
Percent Full	100.0	%
Critical Slope	0.013359	ft/ft
Velocity	6.45	ft/s
Velocity Head	0.65	ft
Specific Energ	1.90	ft
Froude Numbe	1.87e-4	
Maximum Disc	8.51	cfs
Discharge Full	7.91	cfs
Slope Full	0.015000	ft/ft
Flow Type	Subcritical	

Cross Section
Cross Section for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Discharge

Section Data		
Mannings Coeffic	0.013	
Slope	015000	ft/ft
Depth	1.25	ft
Diameter	15	in
Discharge	7.91	cfs





Size of Stone that will Resist Displacement for Various Velocities and Side Slopes (U.S. Department of Transportation, 1978).

EARTHFAX ENGINEERING, INC.
ENGINEERS / SCIENTISTS

PROJECT RED BUTTE PAGE 6 OF 6
COMPUTED BRD DATE 09/26/2012
CHECKED _____ DATE _____

ATTACHMENT D

Salt Lake County Supplemental Specification to APWA
Standard Specification 31 37 00 – Riprap or Rock Lining

SECTION 31 37 00
RIPRAP OR ROCK LINING

This specification supplements APWA Standard Specification Section 31 37 00. In cases of conflict between this specification and APWA Section 31 37 00 this specification shall govern.

PART 1 GENERAL

1.1 GENERAL

A. This section covers furnishing and placing the granular filter and loose riprap materials in accordance with these specifications and in conformity with the lines, grades, and dimensions shown on the drawings or as directed by the ENGINEER.

1.2 REFERENCES

A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. American Society for Testing and Materials (ASTM)

ASTM C-127 Specific Gravity and Absorption of Coarse Aggregate.

ASTM C-535 Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

1.3 SUBMITTALS

A. The following shall be submitted:

1. Certification from a certified independent laboratory that the riprap meets the material properties of this specification.
2. A sample of the riprap to be used for construction.

1.4 STORAGE OF MATERIALS

A. Materials shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials.

PART 2 PRODUCTS

2.1 GRANULAR FILTER

A. Granular filter sources shall be approved by the ENGINEER prior to use.

B. Concrete masonry or concrete pavement may not be used for granular filter.

C. Granular Filter shall be well graded with additional gradation requirements as follows:

GRANULAR FILTER GRADATIONS

% Smaller Than Given Size By Weight	Size (Inches)
90-100	3
35-90	¾
0-30	No. 4
0-15	No. 16
0-3	No. 200

D. The CONTRACTOR shall be responsible for obtaining (by selective mining, crushing, screening, or some other method) drainage rock will meet the specified material requirements.

2.2 LOOSE RIPRAP

A. Riprap shall consist of quarry stone which is sound and durable against disintegration under conditions to be met in handling and placing, and is hard and tenacious and otherwise of suitable quality to ensure permanency in the specified kind of work.

B. Riprap sources shall be approved by the ENGINEER prior to use. Concrete masonry or concrete pavement may not be used for riprap. Riprap shall be well graded with additional gradation requirements for riprap as follows:

LOOSE RIPRAP GRADATIONS

Riprap Designation	%Smaller Than Given Size By Weight	(Inches)	D_{50}** (Inches)
Class I	70-100	12	6
	50-70	9	
	35-50	6	
	2-10	3	
Class II	70-100	15	9
	50-70	12	
	35-50	9	
	2-10	3	

Riprap Designation	%Smaller Than Given Size By Weight	(Inches)	D_{50}** (Inches)
Class III	70-100	20	
USE FOR	50-70	16	12
VA OF I	35-50	12	
STORM DRAIN	2-10	4	
Class IV	70-100	25	
USE FOR	50-70	20	15
CHANNEL	35-50	15	
BANK	2-10	5	
Class V	70-100	30	
	50-70	24	18
	35-50	18	
	2-10	6	
Class VI	70-100	35	
	50-70	28	21
	35-50	21	
	2-10	7	
Class VII	70-100	40	
	50-70	32	24
	35-50	24	
	2-10	8	

** D_{50} = Nominal particle size

C. All stones shall be angular (no rounded rock will be permitted), each piece having its greatest dimensions not greater than three times its least dimensions. All stone shall conform to the following test requirements of the American Society for Testing and Materials Standards:

	Requirements	ASTM Standard
Specific Gravity, minimum	2.60	C-127
Los Angeles Abrasion, maximum percent	40	C-535

D. The CONTRACTOR shall be responsible for obtaining (by selective mining, crushing, screening, or some other method) loose riprap that will meet the specified material requirements.

PART 3 – EXECUTION

3.1 GRANULAR FILTER

A. Prior to placement of granular filter, the subgrades to the granular filter shall be compacted and graded to the lines and grades shown on the drawings.

B. Granular filter shall generally be placed starting at the lowest elevations and working upward. The surface shall be leveled as necessary, to produce a reasonably uniform appearance and the required thickness.

3.2 LOOSE RIPRAP

A. Prior to placement of loose riprap, the granular filter shall be placed and graded to the lines and grades shown on the drawings.

B. Riprap shall generally be placed starting at the lowest elevations and working upward. Riprap shall be placed to the minimum thickness designated on the drawings and shall be positioned in such a manner that will provide uniform distribution of the various sizes of stone and produce a well-keyed mass of rock with the least practical amount of void space. The surface shall be leveled as necessary, to produce a reasonably uniform appearance and the required thickness.

END OF SECTION

February 12, 2013

EarthFax

EarthFax
Engineering, Inc.
Engineers/Scientists
7324 So. Union Park Ave.
Suite 100
Midvale, Utah 84047
Phone 801-561-1555
Fax 801-561-1861
www.earthfax.com

Mr. Chuck Williamson
Stream Alteration Specialist
Utah Department of Natural Resources
Division of Water Rights
1594 West North Temple, Suite 220
Salt Lake City, UT 84114

Subject: Red Butte Creek Repair Project at Site No. 29

Dear Mr. Williamson:

Please find the enclosed check as required for the permit fee for restoration repairs to Red Butte Creek at the Veterans Administration Hospital in Salt Lake City, Utah.

We appreciate your help with the permitting of this project. Please let us know if you have any further needs concerning this project.

Sincerely,

Brad Derrick

EarthFax Engineering
Bradley R. Derrick, P.E.

February 4, 2013

EarthFax

EarthFax
Engineering, Inc.
Engineers/Scientists
7324 So. Union Park Ave.
Suite 100
Midvale, Utah 84047
Phone 801-561-1555
Fax 801-561-1861
www.earthfax.com

Mr. Chuck Williamson
Stream Alteration Specialist
Utah Department of Natural Resources
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1594 West North Temple, Suite 220
Salt Lake City, UT 84114

Subject: Red Butte Creek Repair Project at Site No. 29

Dear Mr. Williamson:

Attached is a copy of the Design Study Report for repair of a storm drain inlet to Red Butte Creek at the Veterans Administration Hospital in Salt Lake City, Utah. Also enclosed is the Joint Permit Application Form with a check for the required application fee.

This report contains the calculations, plan and cross section drawings, and work plan for construction of riprap improvements to the Creek bank and inlet channel. Please note this report addresses the following:

- 100 year occurrence high flow used in the previous repair work on the Creek has been used for the design and is shown in the cross sections
- Stationing and elevations are relative based at the site of the proposed work
- Existing and proposed cross sections both above and below the inlet are included
- Rock (riprap) size is specified from the County specifications, one step larger than calculations require
- Some riparian area vegetation will be used for additional bank stabilization at the weir location

We appreciate your help with the permitting of this project to expedite the construction. Please let us know if you have any further questions.

Sincerely,

Brad Derrick

EarthFax Engineering
Bradley R. Derrick, P.E.